

Machine Guarding Program

1.0 INTRODUCTION

In an academic research environment, machine shops pose a unique set of challenges in terms of risks to users and administrators. The purpose of this Machine Shop Safety Program is to provide guidance to all employees and students at Auburn University who work with machining tools and equipment in order to ensure a safe and productive work environment. All employees and students, who work with operate or anticipate operating energized machinery (woodworking machinery, metalworking machinery, building systems, etc.) shall be appropriately trained to safely operate their equipment and conduct inspections prior to equipment use.

This Machine Guarding Program will help prepare and safeguard employees and students who operate and repair machinery.

This Program offers general guidance and is supplemented by shop and machine specific procedures that are developed and monitored by the Machine Shop Safety Administrator (MSSA).

Employees and students are expected to operate machinery in compliance with this Program and the training provided.

2.0 SCOPE AND APPLICATION

This Program is applicable to all academic departments and their employees and students that operate or repair machinery or supervise work with machinery requiring machine guards.

3.0 DEFINITIONS

Adequate Facility – means a facility which provides satisfactory clearances, power, light, and ventilation.

Authorized User - an employee or student who has received both general machine shop safety training and specific machine tool and equipment training by the designated Machine Shop Safety Administrator (MSSA) or other designated trainer, and is thus authorized to access and use the specific machining tools and equipment using established procedures.

Buddy System - this is a system designed to protect the machine tool user in case of injury. During off-hours when the machine shop is vacant, a "buddy" would be present so that, in the event of an injury, emergency assistance is not delayed.

Guard - an enclosure designed to restrain pieces of abrasive wheels, wheel pulley assemblies, other moving parts or working stock, and to protect the employee and student in the event of breakage or accidental contact with the moving part.

Hand Tool - an instrument used or worked by hand.

Lock-out/Tag-out – means the placement of a lock/tag on an energy-isolating device in accordance with an established procedure, ensuring that the energy-isolating device cannot be operated until removal of the lock/tag.

Qualified Repair Personnel – means a person that through training and/or experience has thorough knowledge of how individual machining tools and equipment are operated and the safety hazards associated with those machining tools and equipment.

Machine Shop - a facility which may contain at least one of the following pieces of equipment: drill press, lathe, band saw, table saw, mill, grinder, buffer, shear, metal punch, jointer, portable power tools, swing arm saw, radial arm saw, planer, slitter, roll-form machine, cold header, multislide machines, drum sanders, belt sanders, veneer cutters, splicers, and alligator shears.

Machine Shop Safety Administrator -means an employee who develops and implements administrative controls to ensure the safety of those using the machine shop.

Metalworking Machinery - a machine that removes, forms, works or shapes metal or is used to assemble parts.

Woodworking Machinery - a machine that removes, forms, works or shapes wood or is used to assemble parts.

4.0 RESPONSIBILITIES

4.1 Deans, Directors and Department Heads

Implement a Machine Shop Safety Program. Designate and authorize an individual who has thorough knowledge of proper machine operation and safe working procedures as the MSSA.

Actively support this Program within individual units.

Ensure an environment where supervisors and other personnel are encouraged to follow this Program.

Inform Risk Management and Safety of the designated MSSA.

4.2 Designated Machine Shop Safety Administrator

Manage all activities that impact machine shop safety. Examples of these activities include user training, proper use of personal protective equipment, project set up, removal of unsafe machines from service, posting of appropriate signage at work areas, and approval of users in the shop.

Implement a safety plan or adopt this Program as procedure.

Conduct safety inspections of machining tools, equipment and facilities at a minimum of once a year.

Train all employees and students on machining tool and equipment use.

Maintain training documentation as stated.

Maintain a Lock-out/Tag-out procedure prior to servicing or repairing any piece of machinery or equipment. Refer to Risk Management and Safety’s Lock-out/Tag-Program.

Limit student access to tools and equipment. Students using machining tools and equipment beyond established working hours and during weekends shall be prohibited unless prior approval is given by the MSSA and use complies with the “buddy system” part of this section.

Provide eye protection to authorized machine tool users and visitors upon entry into a machine shop.

Act as a safety liaison between the individual department and Risk Management and Safety with the implementation of this Program and all other aspects of machine shop safety.

Establish allowable material use specific for the type of machine, application and environment.

4.3 Supervisors

Implement procedures in accordance with this Program and the departmental Machine Shop Safety Program.

Assure that staff is aware of this Program, instructed on the details of implementation, and provided with equipment and controls. Maintain documentation as required.

Assign resources to support the implementation of this Program.

Contact Risk Management and Safety for technical assistance.

4.4 Employees and Students

Comply with this Program and any further recommendations initiated by the supervisor.

Conduct assigned tasks in a safe manner, wear appropriate personal protective equipment, and only use equipment for which they have been formally trained.

Report any job related injuries or illnesses, questions on health and safety, or any unsafe or unhealthy working conditions to their supervisor.

4.5 Machine Tool Users

Comply with this Program and any further recommendations initiated by the supervisor.

Conduct assigned tasks in a safe manner, wear appropriate personal protective equipment, and only use equipment for which they have been formally trained.

Report any job related injuries or illnesses, questions on health and safety, or any unsafe or unhealthy working conditions to their supervisor.

Individuals will be classified as "Authorized Machine Tool Users" upon completion of training and documented departmental training records.

Operate only the specific machines, tools and equipment they have been trained to use.

Must not wear loose clothing or exposed jewelry while using any machining tool or piece of equipment.

Pull back and secure long hair prior to using machining tools and equipment.

The user shall report defective machinery, equipment and hazardous conditions to the MSSA. Do not remove guards from machinery and equipment except when necessary for servicing.

4.6 Risk Management and Safety

Monitor conformance with this Program.

Conduct machining equipment and facility inspections upon request.

Provide technical support on all aspects of this Program.

Review and revise the Machine Shop Safety Guideline, as needed.

Conduct an incident investigation when appropriate.

4.7 Qualified Repair Personnel

Qualified repair personnel are the only employees that are allowed to remove and repair machine guards or, when necessary, repair machinery with guards removed.

Any removal or maintenance of machine guards will be done in accordance with the manufacturer’s guidelines and this Machine Guarding Program.

Qualified repair personnel are employees with the experience and training to properly repair specific machines, tools or machinery.

5.0 GENERAL REQUIREMENTS

There are many different energized machines which require machine guards to ensure their safe operation. Machine guards alone, however, are not always enough to prevent operator injury. There are some general requirements that must also be followed, that along with machine guarding will help ensure operator safety and help prevent injury. The general requirements for machine guarding are described below.

5.1 Operator Checks and Inspections

At the beginning of each shift operators will visually inspect each machine guard device associated with the machine or tool they will use to ensure that a machine is safe to operate. With the exception of changing a cutting device, only authorized repair personnel will perform routine maintenance, including oiling and changing of necessary parts, but operators are required to possess the knowledge and capabilities to change blades, bits, and other cutting devices. All irregularities in the operation of machine guards will be immediately reported to the supervisor and/or authorized repair personnel. Malfunctioning machine guards will affect the safe operation of machinery and will render the machine unfit for service until such irregularities are corrected. Only authorized repair personnel will conduct other needed maintenance and repairs. Full inspection requirements are provided in Section 11.0 of this Standard.

5.2 Operator Attire

Operators must not wear loose fitting clothing, rings, bracelets, or other apparel that can become entangled in moving machinery, power transmission apparatus, or moving parts. Also, hair-nets or caps should be worn to keep long hair under control and safely away from moving machinery and parts. At minimum sturdy shoes which cover the entire foot should be worn.

5.3 Personal Protective Equipment Requirements

If an employee or student is operating a machine which introduces them to any hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases, then they shall be provided with the appropriate personal protective equipment (PPE) necessary to protect them from the hazard.

In addition, the following University requirements should be used in the selection and use of PPE when using machinery:

* The type of PPE needed depends on the machine being used and the job it is used for. At a minimum, eye protection must be worn at all times. Also, a face-shield may be used in addition to safety glasses or goggles. A face-shield will also protect the face and neck from hot metal fragments created during such tasks as grinding.
* Safety shoes with a reinforced toe can help to reduce injury caused by a dropped tool or stock.
* Ear protection may be necessary due to the increased noise levels produced by energized equipment.

All uses of machinery should be evaluated so that proper PPE can be selected. If you are not sure what PPE to use for a specific job, consult your supervisor or MSSA.

6.0 OPERATING REQUIREMENTS

6.1 Work Capacity

Machines must be used only for work within the rated capacity specified by the machine manufacturer. If an employee or student needs to clear jammed work or clean around the machine it will have to be locked or tagged out of service.

6.2 Housekeeping

Cleanliness around machinery must be maintained at all times. During cleaning, chips or other particles can be removed by brushes or compressed air. If compressed air is used, the nozzle pressure at the discharge end of the air-line should not exceed 30 psi. Compressed air may not be used to blow chips or other debris from an operator's body or clothing. Floors and aisles should be kept in good repair and free from potential hazards and other unsafe conditions such as protruding nails, splinters, holes, unevenness, and other tripping hazards. Floors in working areas should also be provided with an effective means to prevent operator from slipping. Aisles and walkways should be straight as possible, with rounded or diagonal corners. Lines marking the floor around workspaces and aisles may be painted on the floor, or some similar method employed to highlight them.

6.3 Operation

A machine should never be left unattended with the control switch in the "on" position. Also, no blades, cutter heads, or collars should be placed or mounted on a machine arbor unless it has been accurately sized and shaped to fit the arbor. If blades are dull, badly set, improperly filed, or improperly tensioned, they should be immediately removed from service. Sharpening or tensioning saw blades or cutters must be done only by qualified repair personnel.

7.0 SPECIFIC MACHINE GUARDING GUIDELINES

There are many different types of machines that require machine guarding. The following safety guidelines pertain to University owned machinery that require machine guarding devices and shall be observed by all operators.

7.1 Circular, Crosscut, and Rip Saws

Guarding beneath the table level should be provided to enclose the saw blade from unintentional contact and prevent contact with moving parts of the drive mechanism.

Saws must be equipped with a hood that covers the blade and automatically adjusts itself to the thickness of the material upon which it rides. The hood covers the part of the saw blade exposed above the material and is adaptable to cover tilted blades.

When ripping, table saws must be provided with a spreader to prevent the wood's internal stresses from clamping down on the saw blade and an anti-kickback device to prevent the stock from possible kickback.

7.2 Radial Saws

Radial saws must be equipped with a hood that encloses the saw blade and the arbor ends. The lower section of the hood must be hinged so it rises and falls and adjusts itself automatically to the thickness of the material as the saw passes through it. An anti-kickback device or hold-down wheels must also be installed on saws used for ripping. The device must be adaptable to any thickness of stock. Blades must not extend beyond edge of table.

7.3 Band Saws

Both upper and lower wheels of a band saw must be completely enclosed on both sides. The enclosures should be capable of being removed easily to permit saw blade maintenance. The working part of a saw blade, between the guide rolls and the upper wheel enclosure, must be guarded to prevent accidental contact with the saw blade. The guard must be self-adjusting and attached to the gauge so that, in any position of the gauge, the guard completely covers the portion of the saw blade between the guide rolls and the upper wheel enclosure.

7.4 Jointers

Each hand-fed planer and jointer with a horizontal or vertical head should be equipped with a cylindrical cutting head, the knife projection of which must not exceed 0.125 inch (0.31 centimeters) beyond the cylindrical body of the head. Also, jointers with front-table-mounted fences must be equipped with an adjustable device to prevent thin stock from slipping laterally under the portion of the fence at the rear of the table. An automatic guard must be provided that covers the section of the cutter head near the operator (on the working side of the fence) and contacts the wood to prevent any opening from remaining between the guard and wood during the operation. The guard should also cover the section of the cutter head on the nonworking side of the fence, especially when the fence is moved toward the automatic guard. The guard over the section of the cutting head on the rear side of the fence should consist of a sliding metal shield that automatically adjusts to the exposed length of the cutter head.

7.5 Power Feed Planers

Guards must be provided for feed rolls, cutting heads, and hold-down rolls at the discharge end. A metal strip in front of the rolls under which the material may pass should guard feed rolls. This prevents an operator's fingers from being drawn into the rolls while feeding the machine. Where the top roll is corrugated, the strip should extend over the top of the roll. Cutting heads and discharge rolls must be guarded by a solid metal enclosure of substantial construction. The hood of an exhaust system may form part or all of the enclosure. When other than corrugated top feed rolls are used, an anti-kickback device should be installed.

7.6 Shapers

Shapers must be equipped with a braking device that brings the cutting head to a stop within 10 seconds after power is shut off. A guard must enclose cutting heads. The guard must not be less than the greatest diameter of the cutter. Whenever possible, hold-downs and jigs should be used to limit exposure of hands to cutters. It is good practice when a blade is removed from a spindle for sharpening, or for some other purpose, that all other blades be removed at the same time.

7.7 Lathes

Rotating, cutter-head type lathes must be provided with a hinged metal shield or hood that completely covers the knives and material when the machine is in operation. Exhaust system hoods may be included as part of the guard if they comply with standard guard designs. Automatic lathes should be equipped with a brake that brings the rotating material to a quick, but not instantaneous, stop after the power is shut off.

7.8 Sanding Machines

Feed rolls of self-feed sanding machines should be protected with a semi-cylindrical guard to prevent hands from coming in contact with the in-running rolls at any point. The guard and its mounting should be designed to remain in adjustment for any thickness of stock. Drum/disk sanding machines should have an exhaust hood, or other guard, so arranged as to enclose the revolving drum/disk, except for the working portion of the drum/disk above the table. Belt sanding machines should be provided with guards at each nip point. These guards must effectively prevent hands or fingers from coming in contact with the nip points. The unused run of the sanding belt must be guarded against accidental contact.

7.9 Boring and Mortising Machines

Safety-bit chucks with no projecting set screws or projecting chucks shall be used. Boring bits should be provided with a guard that will enclose all portions of the bit and chuck above the material being worked. The top of the driving mechanism must be enclosed. If there is a counter weight, one of the following or, an equivalent, must be used to prevent the weight from dropping:

* It shall be bolted to the bar by means of a bolt passing through both bar and counterweight;
* A bolt shall be put through the extreme end of the bar;
* Where the counterweight does not encircle the bar, a safety chain shall be attached to it; and,
* Other types of counterweights shall be suspended by chain or wire rope and shall travel in a pipe or other suitable enclosure wherever they might fall and cause injury.

Universal joints on spindles of boring machines shall be completely enclosed in such a way as to prevent contact by the operator. Each operating treadle shall be covered by an inverted U-shaped metal guard, fastened to the floor, and of adequate size to prevent accidental tripping.

7.10 Tenoning Machines

Feed chains and sprockets of double end tenoning machines must be completely enclosed, except for that portion of chain used for conveying the stock. Sprockets and chains must be guarded at the sides by plates projecting beyond the periphery of sprockets and the ends of lugs at the rear ends of frames over which feed conveyors run. Metal guards when used must cover each tenoning machine that has cutting heads and saws. These guards should cover at least the unused part of the periphery of the cutting head. Where an exhaust system is used, the guard may form part or the entire exhaust hood.

7.11 Mechanical Power Presses

For mechanical power presses, point-of-operation guards must be in place and secured for every operation on the press when the die opening is greater than ¼ inch. If the die opening can be secured so that the opening is never more than ¼ inch, then a point-of-operation guard is not required. Point-of-operation guards for mechanical power presses must accomplish the following:

* Prevent or stop the normal press stroke if the operator’s hands are in the point of operation; or
* Prevent the operator from reaching into the point-of-operation as the die closes; or
* Withdraw the operators hands if they are within the point-of-operation as the die closes; or
* Prevent the operator from reaching the point of operation at any time; or
* Require the operator to use both hands to operate the machine where the controls are located at such a distance the slide completes the downward travel or stops before the operator can reach into the point of operation; or
* Enclose the point of operation before a press stroke can be started to prevent the operator from reaching into the danger zone before the die closes or enclose the point of operation prior to cessation of the slide motion during the downward stroke.

7.12 Drill Presses

Drill presses must have guarding over the motor, belts and pulleys. An adjustable guard may be installed to cover the unused portion of the bit and chuck above the material being worked. Projecting chucks and set screws should be replaced with non-projecting safety bit chucks and set screws. Cover operator controls so the machine cannot be started accidentally.

7.13 Grinding Machines

Install safety guards over spindle end, nut and flange projections. Ensure that an adjustable and rigid work rest is located on offhand grinding machines and that the rest can be adjusted to within 1/8 inch of the wheel. The adjustable tongue guard on the top side of the grinder shall be used and kept within a ¼ inch of the wheel. The angle between the tongue guard the horizontal plan shall not exceed 65°. Foot operated grinding machines shall have a guard to prevent accidental activation.

8.0 ELECTRICAL SAFEGUARDS

All machinery must be installed according to the National Electric Code (NEC) and to the manufacturer’s requirements. If machines have exposed non-current carrying metal components, they have the potential to become energized and should be grounded. Control switches should be available to employees and students at their operating positions so they do not need to reach over moving parts of machinery. Also, machine controls must not be wedged for continuous operation.

Machines that are not adequately safeguarded to protect the employee and student during an under-voltage situation or a power failure must have an under-voltage protective device installed. This device prevents the machine from starting up after a power interruption, which may, in some cases, expose the employee and student to the hazards of moving parts.

Before performing maintenance or major adjustments to moving parts that require panels and guards be removed, all machine energy sources or energy isolating devices must be locked and/or tagged out. (Refer to the University’s Lockout/Tagout Program for more information.)

9.0 MACHINE INSTALLATION

Machines designed for fixed locations or that might tip over should be securely fastened to the floor or other suitable foundation to eliminate all movement or "walking." Small units should be secured to benches, tables, or stands of adequate strength and design. Weight limitation of floors or foundation should be considered prior to machinery installation. Machines should be arranged in a manner that permits an even flow of materials and eliminates backtracking and crisscrossing. Adequate space should be provided to allow material handling with the least possible interference from or to workmen or other machines. Machines should be located so it will not be necessary for an operator to stand in or near an aisle. Additionally, the layout of machines should allow for easy maintenance and repair.

It is recommended that the height of the table or point of operation above the floor for various machines be as shown below.

|  |  |
| --- | --- |
| Machine | Height in. (m) |
| Circular Saws (hand fed) | 36 (.92) |
| Circular Saws (power fed) | 32 (.82) |
| Band Saws | 46 (1.18) |
| Shapers | 36 (.92) |
| Jointers | 33 (.85) |
| Lathes | 41 (1.05) |
| Sanders | 36 (.92) |
| Radial Arm Saws | 39 (1.0) |

Normally, machines that develop fine dust and fumes that are hazardous to employees and students should be equipped with effective hoods and connected to local exhaust ventilation (LEV) system.

10.0 MAINTENANCE REQUIREMENTS

Qualified repair personnel will adhere to the following protocol during the routine maintenance of machine guards and machinery:

* Lock and Tag out power supply prior to repairing the guard. Locking out the power supply will prevent accidental startup of tool while maintenance is being performed;
* Use only replacement parts equivalent with those in the original design;
* Do not alter the guard or guard parts;
* Do not add any parts not supplied by the manufacturer nor delete any parts supplied by the manufacturer; and,
* Keep the machine and its guards in clean and safe operational condition.

10.1 Maintenance Cycle for Machine Guards

A planned maintenance program should be implemented consistent with the machine manufacturer's recommendations and be conducted by the department’s MSSA. No repairs will be made while the machine is NOT locked out.

11.0 INSPECTIONS

Machine Guard inspections are required before the machine is placed into use.

11.1 Care and Use

All employees and students will operate equipment in accordance with the manufacturer’s instructions. Most machine guards are designed to be “fixed” to the machine. These guards must not be removed unless authorized by the manufacturer or by qualified repair personnel. Machine guards may be removed if they are designed to be removed for cutting device changes or to make small cuts. ONLY qualified repair personnel will remove all other guards.

All irregularities in the operation of machine guards will be immediately reported to the supervisor and/or qualified repair personnel. Malfunctioning machine guards will affect the safe operation of machinery and will render the machine unfit for service until such irregularities are corrected.

11.2 Pre-Use Operational Check

Instructions for pre-use checks will be readily available to employees and students. Appendix A contains a pre-use checklist for machine guards. It is recommended that the pre-use checks be located in areas that will facilitate ease of use, such as on a clipboard near a tool crib. Pre-use checks are performed daily (once a shift) and are intended to identify potential hazards that may be encountered from using a machine with damaged and/or defective guards. If at any time a machine guard is in need of repair, defective, or unsafe, remove the machine from service until its guard(s) has been restored to a safe operating condition. Place a red “out of service” tag on the machine with a description of the problem, date reported and who reported it and then give the description of the problem to the MSSA or supervisor.

11.3 Initial Inspection of New and Rented Equipment

Prior to initial use, all new or newly arrived purchased or rental machines will be inspected by qualified repair personnel to ensure compliance with the provisions of this safety Program. For new equipment, an initial inspection will verify that requirements of the purchase order (or rental agreement) have been met and that the equipment is suitable for its intended use. All machines should meet the design and construction requirements identified in the OSHA standards.

11.4 Annual Inspection Requirements

The MSSA shall conduct annual machine tool, associated equipment, and facility safety inspections. All machine tools and equipment that are in disrepair shall be removed from service and locked out until properly repaired. Documentation of these inspections shall be maintained by the department and be made available to Risk Management and Safety upon request.

12.0 OPERATION AND MAINTENANCE RECORD

The authorized repair personnel and qualified supervisor should maintain an Operation and Maintenance (O&M) record for each machine. The record should contain information necessary to inspect, maintain, test, and evaluate the machine guard. A typical record would contain the following types of documentation, as applicable:

* Manufacturer's operation and maintenance manuals;
* Documentation for replacement parts and guards;
* Documentation from the manufacturer authorizing modifications to the guard;
* Inspection procedures and inspections records; and,
* Records of repair, modification, and overhaul.

For machines on rental, ensure that a suitable maintenance and inspection program is established for the duration of the rental period.

13.0 TRAINING

Only authorized users as defined by this Guideline are permitted to operate machining tools in University facilities.

Training of authorized users shall be performed by the designated MSSA or other qualified person who has thorough knowledge of how individual machining tools and equipment are operated, the safety hazards associated with those machining tools and equipment, and specific actions to take in case of an emergency.

Length and type of training for specific machines shall be determined by the designated MSSA or other qualified person. General machine shop safety training in addition to individual machine training shall include: use of personal protective equipment, guard positioning, prohibited use of loose clothing and jewelry, machining tool and bit maintenance, as well as hand tool and facility safety.

Individual departments must maintain training records. Training records must include the specific machining tool or other equipment the individual was trained on, date of training, and the signature of the trainee and trainer.

This training information shall be posted in the designated machine shop, other machine tool user area, or in a central location.

Individuals will be classified as "Authorized Machine Tool Users" upon completion of training and documented departmental training records. The MSSA will determine what method of identification will be used to distinguish between authorized users and those who have not been authorized.

Re-training shall be provided if there is a change in job assignment, change in machine tool or equipment use, or additional jobs present a new hazard. Re-training may also occur if the MSSA or other designated trainer determines that it is necessary.

14.0 Employee and Student Access

All University students and employees (i.e. professors, researchers) must have received formal machine shop safety training and be a designated "Authorized Machine Tool User" prior to access and use of machining tools and machining equipment in machine shops and other University facilities.

In accordance with this Program, the designated MSSA shall implement a mandatory "buddy" system for all Authorized Machine Tool Users while working in machine shops, laboratories or other University facilities that have machining tools or equipment.

Employee and student use of machine shops and facilities with machining tools and equipment shall be limited to established hours of operation. Using machining tools and equipment beyond established working hours and during weekends by Authorized Machine Tool Users is prohibited unless the designated MSSA has issued prior approval and the buddy system is implemented.

Appendix A

Pre-Use Machine Guard Inspection

Most machine guards are simple in nature and only a visual check is required. Some machine guards involve stops, sensors, etc. and require a more thorough inspection. Always check the manufacturer’s recommendation when in doubt.

Before using a machine that requires machine guards inspect for the following:

General components:

* Guards prevent worker’s hands, arms, or other body parts from making contact with point of operation and/or other moving parts.
* Guards are firmly secured and not easily removable.
* Guards permit safe, comfortable, and relatively easy operation of the machine.
* Machine guards are within easy reach of the operator.
* Procedures are established to ensure machine is locked and tagged out before guards are removed.
* PPE is available for this machine

Hazard components:

* Point of operation guards are in place.
* Gears, sprockets, pulleys, and flywheels are guarded.
* Belts and chain drives are guarded.
* Exposed set screws, key ways, and collars are guarded.
* Guards are provided for any other hazardous moving part of the machine.